Concept introduced in the public water supply sector, still sometimes neglected, increasingly applied

Small and agricultural wells: the final frontier

- Small-community applications
- Rural commercial locations, houses of worship, etc.
- Domestic wells
- Agricultural

Much of the world depends on the 6-inch PVC-cased borehole

- The water supply is safe, consistent, and in good shape
- Supplying water does not require excessive amounts of energy
- Minimizes chemicals and other consumable inputs
- Can be managed using locally available technical expertise

Asset management is:

A planning process to reduce cost, and increase efficiency and reliability while achieving service performance and business goals.

Or Sustainable Infrastructure …

Steps of Water System Asset Management (more or less)

- Asset Identification
- Asset Valuation – Objective assessment of depreciation … another talk in its own right
- Inspection and data collection
- Condition assessment/assess deterioration model
- Life-cycle cost analysis
- Maintenance/rehab planning and implementation
- Prioritizing, financial planning
- Water security

Risk evaluation: Probability vs. Impact

- How likely and how often?
- What happens if it fails or degrades?
- Cost when it does?
- This is qualitative and subjective

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<th>Probability &amp; Methods</th>
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<th>Medium</th>
<th>High</th>
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Wells can be bit different from the rest of the engineered water supply system

- In close contact with the non-engineered natural system
- Multiple rock layers, each with its own chemistry and electrical potential
- Large surface areas in contact with untreated water: Well screens and pumps
- Long and slim with limited access, no way to dig up and replace

Asset ID and Valuation

- Distinct ID and location
- Valuation:
  - Replacement cost (physical)
  - Value of water produced
  - To replace it (asset + yield)

What does it cost us when this well production is down or lost?

Inspection and data collection for the following:

- Condition assessment/assess deterioration model
- Life-cycle cost analysis
- Maintenance/rehab planning and implementation
- Prioritizing, financial planning
- Water security

You know, like furnace/AC inspection

Erik Daily photo Wisconsin State Journal 2016
Condition Assessment: Wells
- As with distribution pipes (less like a furnace), well deficiencies or failures can remain hidden.
- Unlike distribution pipelines, reactive repair or replacement of wells (or parts of wells) is at best undesirable and at worst not feasible.
- However, current or potential problems can be prevented or slowed
  - Detected and tracked with available methods, permitting preventive maintenance actions and treatment.

A challenging environment impacts AM and inadequate AM (including lack of active environmental monitoring and control) opens the way to poor performance and water quality

Beyond condition assessment (a static thing), risk assessment: With data we can predict mechanisms that will degrade well performance, and the timing reasonably well – and you really should plan accordingly

Well performance testing
- Test plan
- Accurate water level measurement
- Timed for analysis

Wellfield AM condition assessment
- The “wild” - engineered interface
- Limited access
- Limited feedback

Diagnostic Methods: How to find out what you need to know
- Well performance analysis: Ongoing water levels, flow rates, well test results
- Physical-chemical water quality (pH, conductivity, Fe, hardness, etc.)
- Microbial indicators of biofouling and biocorrosion
- Pulled components (examine)
- Downhole video
- Power usage, indications of wear

Accurate flow measurement
Geologist taking data
Specific capacity not the whole story: Step-drawdown test analysis to determine well loss components

Intercept (B) associated with linear (aquifer) loss
Slope (C) associated with near well nonlinear loss

Component inspection

Video
- Before and after well service
- Assessing problems
- Quality
- Archiving over time to see change
- Archiving can be a problem: media, bulk, storage system?

Biological testing for asset management or tracking contaminant sources
Biological testing

- Baseline and troubleshooting: What is the problem, or what are the challenges?
- Basic: Much easier than it used to be
- Advanced: Incredible amounts of useful data
- Municipal/major industrial (brewery) or environmental clean up: Long-term trend line monitoring, early warning
- Domestic or irrigation: Analyze a problem, then switch to performance or time basis
- Interpretation and explaining – another skill set

Sand and fines (grit)

- Obviously hard on pumps (risk assessment: what’s that worth to you)
- Impacts downstream (irrigation emitters)
- Evaluation by testing, triggering
- Well inspection and response

Facility Memory

- Wells/wellfields: Need long-interval (days to weeks) data point collection intervals
- Storage and retrieval: need scale of decades
- Customer should store their own data (vendors – even you and I – come and go)...
- Think long-term: Store as something retrievable long-term
- Hard-copy (paper records) a really good choice, especially for smaller systems (domestic, a few irrigation wells, village)

Histories: A 34-year well specific capacity history

- Under-developed
- Had a good stretch there
- Doing “the same old” for years
Detect anomalies ("anomaly" – not normal, unusual)

Then, use the information!
- You do not have to guess and work in the dark
- Knowing your costs, hydrologic factors such as specific capacity, water quality, power usage
- Keeping good records to do this
- Know your benefits as well as costs

Assessing vulnerability (risk)
- Contamination has to be within the watershed – surface or ground water
- There has to be an active source
- Hydrologic constraints
- What are the mitigating factors?

Count the cost: Can you afford to skip the PM or risk assessment?
- Can you afford to do without that well during the dry season?
- New pump every 5 years?
- The only water supply you have, and you haven't budgeted to drill a new well?
- The new treatment system if contaminated?
- And so forth?

Small system? Remote? Developing world? Can’t afford these methods?
1. You can’t afford the alternatives
2. We mostly work with small systems
3. You can do it: It need not be complicated

Small system AM
- Everything is smaller and more delicate (PVC casings, plastic this and that)
- Less likely to try heroic rehabilitation
- Pumps more likely remove and replace
- Diagnostics at a troubleshooting point, then time or performance-based
- Available funds margins lower than for competent municipal or industrial
- More likely run to failure – how to “bend the curve”?
Some smaller video units pretty good

Remote automated AM

- “SCADA” has become more user friendly and cost-effective
- Provide a remote-monitor service
- Service triggered by performance factor
- Annual contract
- Check with vendors at the show

Any questions? You can do this.
We do this talk all day in more depth, BTW

Inspection Exercise
- Are you doing maintenance programs or asset management for customers?
- What would make it worth your while?
- What would make it worth their while (usually level of service, as with furnace/AC): No water = bad.
- What would that service look like in your organization? How many people? Costs? Time?
- What to include? Levels of service?
- What to charge?
- Benefits to your organization and the clientele?

Thanks for your attention!